Joint Program Executive Office
Joint Tactical Radio System

Lightweight Application Environment Profile (AEP)




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JTRS SCA Working Group

JPEO JTRS

Task Overview

- **Objective**
  - To promote portable and reusable code on more constraining environments such as micro controllers or Digital Signal Processors (DSP) without decrease performance, increase latency, and minimum code size increase.
- **Benefits**
  - Development Time – decrease the development time to integrate and reuse code
  - Portable – minimize the code changes when reusing code that is being ported
  - Reuse – increase the reuse of code
- **Impact**
  - SCA application DSP code

Solutions

- POSIX Profiles Review
- Lightweight (LW) AEP POSIX Profile Recommendation
- POSIX C Functions Recommendation
- POSIX DSP OS Support
- Summary of Recommendation

POSIX Profiles Review

- **IEEE Standard for Information Technology— Standardized Application Environment Profile (AEP)—POSIX® Realtime and Embedded Application Support**
  - IEEE Std 1003.13™-2003 (Revision of IEEE Std 1003.13-1998)
- **Profiles**
  - PSE51: The Minimal Realtime System Profile
    - PSE51 systems are typically embedded in larger systems dedicated to unattended control of one or more special I/O devices.
  - PSE52: The Realtime Controller System Profile
    - These systems are an extension of the Minimal Real-time (RT) System Profile. Support for a file system interface and asynchronous (nonblocking) I/O interfaces has been added.
  - PSE53: The Dedicated Realtime System Profile
    - An extension of the RT Controller System Profile. Support for multiple processes added.
  - PSE54: The Multi-Purpose Realtime System Profile
    - These systems include all the functionality of the other three profiles. They provide comprehensive functionality and run a mix of differing RT and non-RT tasks.
  - PSE5X: Any one of the PSE51, PSE52, PSE53, or PSE54 profiles.
- **SCA AEP is subset of PSE52**

LW AEP POSIX Profile Recommendation

POSIX Features	SCA AEP	LW AEP	Comments
POSIX.1 Option Requirements	x	x	LW Removed : _POSIX_ASYNCHRONOUS_IO, _POSIX_FSYNC, _POSIX_MEMLOCK_RANGE, _POSIX_MEMLOCK, _POSIX_NO_TRUNC, _POSIX_SYNCHRONIZED_IO, _POSIX_THREAD_SAFE_FUNCTIONS, _POSIX_THREAD_PRIO_INHERIT, _POSIX_THREAD_PRIO_PROTECT
POSIX_SINGLE_PROCESS Functions			
POSIX_MULTI_PROCESS Functions			
POSIX_JOB_CONTROL Functions			
POSIX_SIGNALS Functions			
POSIX_SIGNAL_JUMP Functions			
POSIX_USER_GROUPS Functions			
POSIX_FILE_SYSTEM Functions	x		No File System behavior required for LW AEP
POSIX_FILE_ATTRIBUTES Functions			
POSIX_FD_MGMT Functions	x		No File and Directory Management behavior required for LW AEP
POSIX_DEVICE_IO Functions	x	x	How much device i/o is needed for LW AEP? open, read, write, close

LW AEP POSIX Profile Recommendation

POSIX Features	SCA AEP	LW AEP	Comments
POSIX_DEVICE_SPECIFIC Functions			
POSIX_SYSTEM_DATABASE Functions			
POSIX_PIPE_Function			
POSIX_FIFO Function			
POSIX_C_LANG_SUPPORT Functions	X	X	LW AEP is slightly less by the removable of *_r (thread safe operations), also added mem* functions (memcmp, memcpy, memmove, memset) for both AEPs.
POSIX_C_LANG_MATH Functions	X	X	Added operations to both the SCA AEP and LW AEP. Added acosh, asinh, atanh, exp2, log2, round, and trunc.
POSIX_C_LANG_JUMP Functions	X	X	Same as PSE51 requirement, the smallest R/T POSIX profiles
POSIX Semaphores	X	X	Same as PSE51 requirement
POSIX.1 Timer Functions	X	X	Same as PSE 51 requirement, this is still being evaluated
POSIX Threads	X	X (subset)	A subset, eliminated cleanup_xxx, cond_xxx, condattr_xxx, detach, getspecific,key_xxx, kill, mutexattr_xxx,once,setcancelstate,setcanceltype,setsepcific,sigmask,testcancel. Partial attr_xxx - pthread_attr_getschedparam();pthread_attr_getstacksize();pthread_attr_init();pthread_attr_setschedparam(); pthread_attr_setstacksize(). This is still being evaluated.
POSIX Thread Safe Option Requirements Behavior	X		Not Required, Eliminated POSIX thread safe functions (asctime_r, ctime_r, gmtime_r, localtime_r, rand_r, readdir_r, strtok_r) not part of c89.

POSIX C Functions Recommendation

- **Leading compilers support:**
  - C Standard: ANSI X3.159-1989 (C89), which is the same as ISO/IEC 9899:1990.
  - C++ Standard: ISO/IEC 14882:1998
  - Not supported: C95, C99, C++ 2003, C++ TR1.
  - Not supported C operations are: *_r operations, nor atoll and time (?).

- **Recommendation is based upon ANSI X3.159-1989 (C89) with some C99 extensions such as Math functions**
  - Supplement with a SCA standard types header file.
  - C99 did add some standard types header files.

POSIX DSP OS Support

- **Multiple COTS products have been identified that provide the proposed capability**
  - Execute on popular commercially available DSPs
  - SCA v2.2.2 AEP Compliant
  - pthreads, semaphores, mutexes, message queues, etc.

Summary of Recommendation

- **Subset of SCA GPP AEP functionality**
  - Operating System
    - Device I/O (subset)
    - Pthreads (subset)
    - Semaphores
    - Timers
  - C Language
    - Recommendation is based upon ANSI X3.159-1989 (C89) with some C99 extensions such as Math functions
    - Math functions same between SCA AEP and LW AEP. Both float and double functions supported along with some c99 functions. Added acosh, asinh, atanh, exp2, log2, round, and trunc.
    - C Language Support functions does not support *r (thread safe functions). Also added mem* functions for both AEPs;
    - Jump functions supported